What are the Opportunities and Limitations of Digital Health Interventions?

Dr. Tobias Kowatsch

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Anatomy of Digital Health Interventions

Example: Obesity

Distal Outcome
Practical Problem

Body Mass Index

Justificatory Knowledge

Proximal Outcome(s)

Physical Activity

Stress Management

Diet Behavior

Justificatory Knowledge

Micro-Intervention(s)

Research Focus

Biofeedback-based Breathing Training

Just-in-time Adaptive Intervention (JITAI)
- Decision Rules
- Micro-randomized controlled trials

Digital Coaching
- Autonomy
- Competence
- Relatedness

Self-learning Digital Health Intervention (SelDHI)
- Sensing and support
- Individual, peer and contextual learning

MobileCoach Reference Platform for Digital Health Interventions
Current state-of-the-art on digital coaching

Health Psychology
- Health Behavior Models
- Behavioral Change Techniques
- Motivational Interviewing & Coaching
- Just-in-time Adaptive Interventions
  (e.g., Marsch et al. 2014, Nahum-Shani et al. 2015 & 2016, Susan et al. 2013, Pender et al. 2010, Haug et al. 2013)

Information Systems
- Decision Support Systems
- Determinants of Technology Adoption
  (DSS Journal, Davis 1989, Venkatesh et al. 2003; 2012)

Computer Science
- Self-Learning Digital Health Interventions for Sensing & Support
- Chatbots & Digital Assistants
  (e.g., Filler et al. 2015, Barata et al. 2016, Jaques et al. 2016, Pejovic et al. 2015, Pejovic & Musolesi 2015, Mehrotra et al. 2015)

Scientific State-of-the-art

Computer-Mediated Communication
- oviva.com
- ginger.io
- omadahealth.com

Chatbot-based Communication
- amazon alexa
- Google Allo
- koko
- Siri

Practical State-of-the-art
Current state-of-the-art on digital coaching

**Scientific State-of-the-art**

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**Practical State-of-the-art**

**Computer-Mediated Communication**
- Significant use of technology but not that scalable as it could be!

**Health Psychology**
- A holistic approach is yet missing that shows a combination of these approaches effectively working in the long-term.

**Computer Science**
- Lacks technical maturity, domain knowledge, openness, integration into health care systems (provider & payer) & important personal contact
Digital Coaching with a Virtual Nurse?

Response to a relational agent by hospital patients with depressive symptoms

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“We conclude that empathic agents represent a promising technology for patient assessment, education and counseling for those most in need of comfort and caring in the inpatient setting.” (Bickmore et al. 2010)

http://iwc.oxfordjournals.org/content/22/4/289
Digital Coaching with a Virtual Nurse?

MEET MOLLY
YOUR VIRTUAL NURSE.

She is here to give your clinician 20% of their day back. Who is she? A breakthrough, virtual nurse who provides proven, customized monitoring and follow-up care, with a strong focus on chronic diseases.

- Innovative avatar-based technology
- Mimics the bedside manner patients need
- Real time data for immediate care decisions
- Care maintained between office visits

http://sense.ly
Digital Coaching with a Virtual Coach?

http://www.web.lark.com
Interventions [...] **via text messages** seem to be an **effective tool** for increasing adherence to physical activity guidelines in everyday life. The comparable effects ... suggest that **automated text messages** may be just as **effective as personalized messages** from the romantic partner.
Select Projects & Lessons Learnt
Mobile Sensing & Support for People with Depression

http://mhealth.jmir.org/2016/3/e111/
Mobile Sensing and Support for People With Depression: A Pilot Trial in the Wild

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"Subjects who used the app for an extended period of time showed **significant reduction** in self-reported **symptom severity.**"

http://mhealth.jmir.org/2016/3/e111/

But: **high drop-out rate. One rationale? standalone app.**
Eating Disorder Intervention for Children affected by Obesity and Anorexia Nervosa

Ostschweizer Kinderspital
Du hast nun als erstes die Möglichkeit, einen Coach auszuwählen. Möchtest du lieber von Anna oder von Lukas Nachrichten erhalten?
First data of 5 adolescents (4 male) resulted in a
• response rate of **90.3%** out of all SMS.
• Exercises were performed **1.6±0.4** times/day.
• **BMI decreased by 4.5%** (D=-0.4 to -3.2 kg/m²).

(Büchter et al., to appear)
Scalable Public Health Coaching for Young Adults affected by Substance Abuse & Stress

MobileCoach Alcohol, Tobacco & Ready4Life
Swiss Research Institute for Public Health and Addiction at Zurich University & Lungenliga Schweiz
Scalable Public Health Coaching

MobileCoach Alcohol

74.6% out of 1380 students participated. Only 1% unsubscribed from the study. 93% participated in the follow-up assessment.

Results

The prevalence of risky single-occasion drinking decreased by 5.9% (from 47.2% to 41.3%) in the intervention group and increased by 2.6% (from 42.7% to 45.3%) in the control group compared to baseline assessment (OR=0.62, 95% CI=0.44-0.87).


MobileCoach Ready4Life

LUNGENLIGA

Be Cool – Stress management
Be Smart – Social skills
Be Healthy – Drug abuse

After 2 months, already 1172 subjects participate and the physical coach handles them by only 2 x 15 minutes per day.

http://www.r4l.swiss
Childhood Obesity

PathMate 2

Ostschweizer Kinderspital

UNIVERSITÉ DE GENÈVE

UNIVERSITÄT DES SAARLANDES

FNS SNF

SWISS NATIONAL SCIENCE FOUNDATION

DFG
Childhood Obesity

Patient View

Pre-defined Answers
Childhood Obesity

Patient View

Dashboard view with gamification elements

Day 120
75% Progress
55% Challenges
67 Keys

34% (2x) Relax
71% (10x) Steps
21% (2x) Photo
81% (12x) Question
Childhood Obesity

Caregiver View

Digital Coach

Physical Coach
Our Implications
Implications for Caregivers

1. Personal **contact is key** but may be complemented by **scalable digital coaching**.

2. Build self-learning **Digital Health Interventions** that will improve by ...
   - each interaction / usage (“reinforcement learning”)
   - each additional patient

3. Provide a **digital coaching** during everyday life (**99%**) in combination with high-quality **on-site visits** for those in need (**1%**).
Physical & Digital Coaching – SNF PathMate 2

The Digital Coach (Self-Service Chat Bot)

Supports autonomy and competence but may vary in relatedness, motivation, responsibility and personal bond.

99% ?

The Physical Coach

The primary “person or organization of trust” (e.g. health insurance, general practitioner, university, hospital, patient organization etc.) that introduces the digital coach.

introduces refers to the physical coach in “life critical situations” or in situations where the digital coach is “overstrained” (e.g. beyond FAQ’s).

1% ?

The primary “person or organization of trust” (e.g. health insurance, general practitioner, university, hospital, patient organization etc.) that introduces the digital coach.
The Digital Coach (Self-Service Chat Bot)

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* # of chat messages after the first week (1 PathMate2 Patient)
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References

About Design Theories and Design Science Research

Behavior Change Theories and Health Promotion

Concrete example with regard to our paper
References


References


WHO (2011b) Scaling up action against NCDs: How much will it cost?, Genéve, Switzerland: World Health Organization.